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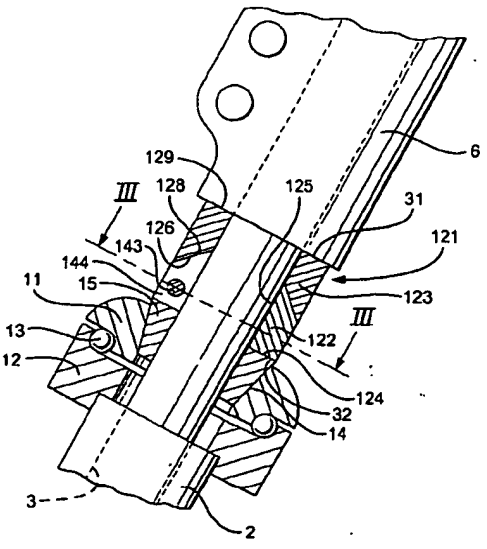
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: BEARING ADJUSTMENT



(57) Abstract: An adjuster for an upper bearing (11,12) of the front forks of a bicycle has two thrust rings (122,123). The lower one (122) has a lower, planar, radially-extending, thrust surface (124), a bore (125) which is a sliding fit on the steerer, and an upper, external, male, 45° conical surface (126). The upper thrust ring (123) has a lower, complementary internal and female, 45° conical surface (128) and a planar, radially extending upper thrust surface (129). The stem (6) has a thrust surface (31) complementary to the upper surface (129) and the compression ring has a similarly complementary thrust surface (32). The lower thrust ring is radially split (141) and has a threaded bore (142) intercepting this split perpendicularly. A grub screw (143) is received in the bore (142). With the steering assembly loosely fitted together, the grub screw (143) released, and the thrust rings resting on the compression ring (15), the stem is pressed down on top of the thrust rings. A stem (6) is then clamped to the steerer (3). There will be vertical play in the bearings. The grub screw is tightened to abut the opposite face (144) of the split (141), to urge the lower thrust ring to increase in diameter. Its conical surface reacts against that of the upper thrust ring, driving the two apart axially of the steerer to drive the compression ring into the tapered bore (14) of the upper race, centring the race on the steerer and taking up the play in the bearings.

BEARING ADJUSTMENT

The present invention relates to a device for adjusting a bearing, particularly in the steering arrangement of a bicycle.

A bicycle frame has a head tube, which is angled slightly back from the vertical at the front of the frame. It is hollow and receives a steerer, i.e. a tube to the bottom end of which the front forks or equivalent are attached and to the top end of which the handle bar is attached. A spaced pair of bearing races is provided between the steerer and the head tube, one at the bottom of the latter and the other at the top. As usual with rolling element bearings, they require adjustment, to reduce the end float to a minimum, without over-tightening and placing a drag on the steering of the bicycle.

Conventionally, the steerer has been threaded at the top bearing and a lockable nut has been provided for bearing down on the upper race of the bearing for its adjustment. Latterly, an arrangement described in US patent No 5,095,770 has become widely used. It employs a split, annular, compression ring, which is tapered downwardly in cross-section. The upper race of the upper bearing has a complementary taper defining a tapered annular region with the steerer and into which the compression ring can be urged. The ring both moves the race axially to adjust it and wedges the race to the steerer, whereby the race and the steerer act as one. Various arrangements are provided for urging the compression ring into its wedging position.

In three US patents Nos 5,544,905, 5,680,798 & 6,167,780, Sheung-Luen Chen describes further improvements on the above patent, in which a split ring which tapers towards each end is urged into the upper race by a complementarily tapered strap tightened by a bolt in tension. The strap contracts the split ring against the steerer, which can give rise to friction and the complementary tapers are relatively shallow, to ensure that the contraction occurs. This shallowness gives rises to a relatively fast movement of the split ring per bolt rotation.

The object of the present invention is to provide an improved arrangement for adjusting top race of a head tube bearing and in particular compressing its adjustment ring where provided.

According to a first aspect of the invention there is provided an adjuster for an upper, bicycle-steering bearing between a frame and a steerer of a bicycle, the adjuster comprising:

- a male/female pair of thrust rings, the thrust rings having:
  - an internal bore of the male thrust ring at least sized to match the outside diameter of a steerer,
  - complementary, male/female wedge-action, abutment surfaces,
  - thrust, end surfaces complementary (i.) to that of an upper race of the bearing or a compression ring therefor and (ii.) to that of an abutment surface of a member to be mounted on the steerer to which the adjuster is to be fitted,
  - a radial split in one of thrust rings, the other being circumferentially continuous,
  - means for adjusting the circumferential extent of the split one of the thrust rings for:
    - expanding the male thrust ring where this is split or
    - contracting the female thrust ring where this is split

  to urge the rings axially apart by wedging action to urge the upper race towards its lower race for adjusting the bearing by reaction against the member mounted on the steerer.

Whilst it can be envisaged that the female thrust ring may be contracted by means of a bolt acting in tension to close a gap in the ring; in the preferred embodiment, the male thrust ring is expandable by means of a grub screw acting in compression to open a gap in the ring.

It should be noted that advantageously in either case, the male ring is not compressed against the steerer, thus not subject to friction with it which could interfere with the bearing adjustment.

Again, whilst it can be envisaged that one only of the male/female pair of wedge-action thrust rings is conical in shape for the wedging action, the other being of rounded cross-section for instance; in the preferred embodiments both thrust rings are conical, one with a male configuration and the other with a female configuration. In either case, the male ring is not compressed against the steerer and subject to friction with it.

Preferably, the conical one(s) of the complementary, male/female wedge-action, abutment surfaces is/are relatively steep, that is to say at angle of approximately 45° or more to a central axis of the thrust rings when engaged together.

Normally, the adjuster will be used with an upper, bicycle-steering bearing, the bearing having:

- an upper race having an internal downwards taper in its bore;
- a lower race;
- an annular, compression ring with an internal bore sized to match the outside diameter of the steerer and an external downwards taper complementary to the taper of the upper race;

the adjuster abutting the compression ring in use for tightening the bearing when the adjuster is tightened.

Again, the adjuster will normally be used with a handle bar stem, which is the member against which the rings react to action to urge the upper race towards its lower race for adjusting the bearing.

According to a second aspect of the invention there is provided an adjuster for an upper, bicycle-steering bearing between a frame and a steerer of a bicycle in combination with a handle bar stem:

- the adjuster comprising a thrust ring with:
  - a radial split,
  - means for adjusting the circumferential extent of the thrust ring and

- a thrust, end surface complementary to that of an upper race of the bearing or a compression ring therefor,
- the stem having integral therewith:
  - a male thrust extension or a female thrust recess;
- the male thrust extension or the female thrust recess and the thrust ring having complementary, male/female wedge-action, abutment surfaces,

the arrangement being such that:

- expanding the thrust ring where this is male to the stem having a female thrust recess or
- contracting the thrust ring where this is female to the stem having a male thrust extension

to urge the rings axially apart by wedging action urges the upper race towards its lower race for adjusting the bearing.

Preferably the stem is blind and provided with means for clamping to the steerer.

As with the first aspect of the invention, where the adjusting means can be bolt contracting the thrust ring when the latter is female or a grub screw expanding the ring when it is male.

Again as with the first aspect, one only of the male/female pair of wedge-action abutment surfaces may be conical in shape for the wedging action, the other being rounded or both of the male/female pair of wedge-action abutment surfaces can be conical in shape for the wedging action.

Further the wedge angles and bearing abutment details can be as for the first aspect.

To help understanding of the invention, a specific embodiment thereof and a variant will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic side view of the steering arrangement of a bicycle having a bearing adjuster of the invention;

Figure 2 is a partially sectioned side view on a larger scale of the bearing adjuster;

Figure 3 is a cross-sectional view on the line III-III in Figure 2;

Figure 4 is a view similar to Figure 2 of a variant of the bearing adjuster;

Figure 5 is a cross-sectional view on the line V-V in Figure 4;

Figure 6 is a view similar to Figure 2 of another embodiment of the invention;

Figure 7 is another similar view of a further embodiment of the invention.

Referring first to Figures 1,2 and 3, the conventional bicycle components shown are a frame 1 (or at least a front part of it) including a head tube 2, a steerer 3 (hidden in Figure 1 and indicated by broken lines), front forks 4, and handle bars 5. The stem 6, clamped at 7 to the steerer, has a blind top 8, that is to say the steerer does not extend through the top of the stem. This is not conventional.

Upper and lower bearings 9,10 are provided. The upper bearing has upper and lower races 11,12, with a rolling element assembly 13 between them. As taught by the above referenced US patent No 5,095,770, the upper race has a tapered bore 14, into which is urged a tapered compression ring 15 by means of an adjuster of the invention 121. With the adjuster abutting the stem 6 and pressing down on the compression ring, the latter acts between the steerer 3 and the race 11 to press the bearings together and to unify the upper race and the steerer.

The adjuster comprises two thrust rings 122,123. The lower one 122 has a lower, planar, radially-extending, thrust surface 124, a bore 125 which is a sliding fit on the steerer, and an upper, external, male, 45° conical surface 126. The upper thrust ring 123 has a lower, complementary internal and female, 45° conical surface 128 and a planar, radially-extending upper thrust surface 129. The stem 6 has a thrust surface 31 complementary to the upper surface 129 and the compression ring has a similarly complementary thrust surface 32.

The lower thrust ring is radially split 141 and has a threaded bore 142 intercepting this split perpendicularly. A grub screw 143 is received in the bore 142.

With the steering assembly loosely fitted together, the grub screw 143 released, and the thrust rings resting on the compression ring 15, the stem is pressed down on top of the thrust rings. The stem is then clamped to the steerer. There will be vertical play in the bearings. The grub screw is tightened to abut the opposite face 144 of the split 141, to urge the lower thrust ring to increase in diameter. Its conical surface reacts against that of the upper thrust ring, driving the two apart axially of the steerer to drive the compression ring into the tapered bore 14 of the upper race, centring the race on the steerer and taking up the play in the bearings.

Indeed it has surprisingly been found that the desired bearing loading is easily set with the adjuster of the invention and the setting has been found to require little or no adjustment in use.

Turning now to Figures 4 & 5, the lower thrust ring 151 is a continuous, unsplit ring, which is a slidingly fit on the steerer. It has an upper, external, male, 45° conical surface 152 and a transverse lower surface 153. This bears on a split bearing compression ring 115. An upper, strap thrust ring 154 has a lower complementary female conical surface 155 and an upper transverse surface abutting the underside of a stem. The upper thrust ring 154 is radially split 156 and provided with a bolt 157 across the split. The bolt is received in a bore threaded 158 to one side of the split and plain 159 to the other side. Tightening of the screw acts to squeeze the upper ring on the cone of the lower ring thus urging the two rings apart, in analogous manner to the rings 122,123, for taking up the slack in the bearings.

Referring on two Figures 6 & 7, two embodiments of the invention are shown in which only one thrust ring is provided, the stem being provided with a complementary conical surface for wedging action. In Figure 6, the expanding thrust ring 222 is similar to that of Figures 2 & 3, that is having an upper, external, male, 45° conical surface 226, which is split 242 and provided with a grub screw 243. It co-operates with a female conical surface 228 machined in the end of the stem. Once the

stem is tightened onto the steerer, the thrust ring acts directly on it to tighten down the bearing's compression ring. This has the advantage of requiring one fewer component and producing a tidier engineering solution.

In Figure 7, the contracting, strap thrust ring 254 has an upper, female conical surface 255 and a bolt 257. This acts with a male conical surface 252 machined on the end of the stem. Again tightening of the bolt once the parts are fitted tightens the bearing.

It should be noted that the taper/conical angle of the thrust rings, with respect to the axis of the steerer, is steeper than that of the bearing compression ring. This is because the wedging action of the compression ring is an axial action resulting in a radial tightening, whereas the wedging action of the thrust ring is a radial action – in the case of both of the expanding and the contracting rings – producing the axial movement to operate the compression ring. Thus the thrust rings' conical angle can be increased from the order of 45° to the order of 60° or more. The increase reduces the resultant axial movement for a unit change of circumferential size. However much more than 75° is liable to result in inadequate compression of the bearing ring unless the latter is at least partially compressed before the stem is tightened onto the steerer.

The thrust rings and the stems of the above embodiments are aluminium (or aluminium alloy) for lightness. They are anodised for durability and reduction of friction between the complementary, wedge action abutment surfaces. The anodising reduces stiction and assists in fine adjustment of the bearings.

The invention is not intended to be restricted to the details of the above described embodiment. For instance, the lowered tapered thrust surface 152 could be round at its mid-height, and relieved with respect to its tapered shape above mid-height, in other words, it does not need to be precisely the same shape as the surface 155, provided the two are able to co-operate in a wedging action on tightening of the strap ring.

Further, in order to allow a small abutment surface of the thrust ring in contact with the bearing compression ring and an adequate cross-section of the ring for its bolt/grub screw, the thrust ring can be chamfered at its end in contact with the compression ring.

Furthermore, should the adjuster of the invention be insufficiently long for the stem height which is suitable for a tall rider, packing washers to extend its effective height can be provided.

CLAIMS:

1. An adjuster for an upper, bicycle-steering bearing between a frame and a steerer of a bicycle, the adjuster comprising:

- a male/female pair of thrust rings, the thrust rings having:
  - an internal bore of the male thrust ring at least sized to match the outside diameter of a steerer,
  - complementary, male/female wedge-action, abutment surfaces,
  - thrust, end surfaces complementary (i.) to that of an upper race of the bearing or a compression ring therefor and (ii.) to that of an abutment surface of a member to be mounted on the steerer to which the adjuster is to be fitted,
  - a radial split in one of thrust rings, the other being circumferentially continuous,
  - means for adjusting the circumferential extent of the split one of the thrust rings for:
    - expanding the male thrust ring where this is split or
    - contracting the female thrust ring where this is split

  to urge the rings axially apart by wedging action to urge the upper race towards its lower race for adjusting the bearing by reaction against the member mounted on the steerer.

2. An adjuster as claimed in claim 1, the female thrust ring is split with a gap in its circumferential extent and the adjusting means is:

- a bolt threadedly engaged in a bore in the thrust ring on one side of the gap and abutting a seat in the trust ring on the other side of the gap,

the arrangement being such that tightening of the bolt onto the seat contracts the female thrust ring for axial displacement of the male thrust ring away from the female thrust ring.

3. An adjuster as claimed in claim 1, the male thrust ring is split with a gap in its circumferential extent and the adjusting means is:

- a grub screw threadedly engaged in a bore in the thrust ring on one side of the gap and engaging an abutment in the thrust ring on the other side of the gap,

the arrangement being such that tightening of the grub screw onto the abutment expands the male thrust ring for axial displacement of the female thrust ring away from the male thrust ring.

4. An adjuster as claimed in claim 1, claim 2 or claim 3, wherein one only of the male/female pair of wedge-action abutment surfaces is conical in shape for the wedging action, the other being rounded.

5. An adjuster as claimed in claim 1, claim 2 or claim 3, wherein both of the male/female pair of wedge-action abutment surfaces are conical in shape for the wedging action.

6. An adjuster as claimed in any preceding claim, wherein the conical one(s) of the complementary, male/female wedge-action, abutment surfaces is/are relatively steep, that is to say at angle of approximately 45° or more to a central axis of the thrust rings when engaged together.

7. An adjuster as claimed in any preceding claim, wherein the thrust rings are of aluminium or aluminium alloy and anodised.

8. An adjuster as claimed in any preceding claim in combination with an upper, bicycle-steering bearing, the bearing having:

- an upper race having an internal downwards taper in its bore;
- a lower race;
- an annular, compression ring with an internal bore sized to match the outside diameter of the steerer and an external downwards taper complementary to the taper of the upper race;

the adjuster abutting the compression ring in use for tightening the bearing when the adjuster is tightened.

9. An adjuster as claimed in any preceding claim in combination with a handle bar stem, which is the member against which the rings react to action to urge the upper race towards its lower race for adjusting the bearing.

10. An adjuster for an upper, bicycle-steering bearing between a frame and a steerer of a bicycle in combination with a handle bar stem:

- the adjuster comprising a thrust ring with:
  - a radial split,
  - means for adjusting the circumferential extent of the thrust ring and

- a thrust, end surface complementary to that of an upper race of the bearing or a compression ring therefor,
- the stem having integral therewith:
  - a male thrust extension or a female thrust recess;
- the male thrust extension or the female thrust recess and the thrust ring having complementary, male/female wedge-action, abutment surfaces,

the arrangement being such that:

- expanding the thrust ring where this is male to the stem having a female thrust recess or
- contracting the thrust ring where this is female to the stem having a male thrust extension

to urge the rings axially apart by wedging action urges the upper race towards its lower race for adjusting the bearing.

11. An adjuster and stem combination as claimed in claim 10, wherein the thrust ring is female with a gap in its circumferential extent and the adjusting means is:

- a bolt threadedly engaged in a bore in the thrust ring on one side of the gap and abutting a seat in the trust ring on the other side of the gap,

the arrangement being such that tightening of the bolt onto the seat contracts the thrust ring for axial displacement thereof away from the stem.

12. An adjuster and stem combination as claimed in claim 10, the male thrust ring is male with a gap in its circumferential extent and the adjusting means is:

- a grub screw threadedly engaged in a bore in the thrust ring on one side of the gap and engaging an abutment in the thrust ring on the other side of the gap,

the arrangement being such that tightening of the grub screw onto the abutment expands the male thrust ring for axial displacement thereof away from stem.

13. An adjuster and stem combination as claimed in claim 10, claim 11 or claim 12, wherein one only of the male/female pair of wedge-action abutment surfaces is conical in shape for the wedging action, the other being rounded.

14. An adjuster and stem combination as claimed in claim 10, claim 11 or claim 12, wherein both of the male/female pair of wedge-action abutment surfaces are conical in shape for the wedging action

15. An adjuster and stem combination as claimed in any one of claims 10 to 14, wherein the conical one(s) of the complementary, male/female wedge-action,

abutment surfaces is/are relatively steep, that is to say at angle of approximately 45° or more to a central axis of the thrust rings when engaged together.

16. An adjuster and stem combination as claimed in any one of claims 10 to 15, wherein the stem is blind and provided with means for clamping to the steerer.

17. An adjuster and stem combination as claimed in any one of claims 10 to 16, wherein the thrust ring and preferably the stem are of aluminium or aluminium alloy and anodised.

18. An adjuster and stem combination as claimed in any one of claims 10 to 17, with an upper, bicycle-steering bearing, the bearing having:

- an upper race having an internal downwards taper in its bore;
- a lower race;
- an annular, compression ring with an internal bore sized to match the outside diameter of the steerer and an external downwards taper complementary to the taper of the upper race;

the adjuster abutting the compression ring in use for tightening the bearing when the adjuster is tightened.

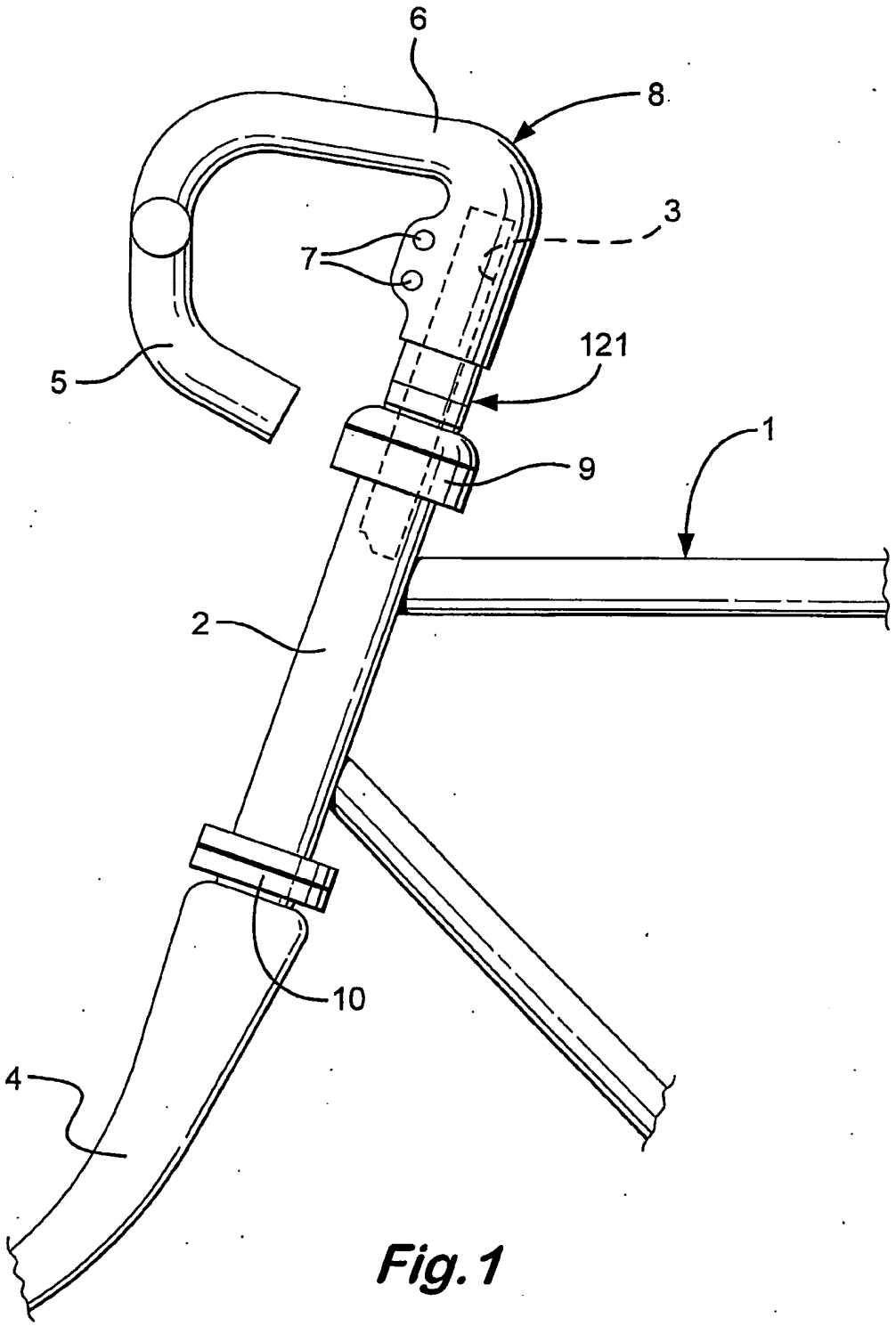


Fig. 1

Fig.2

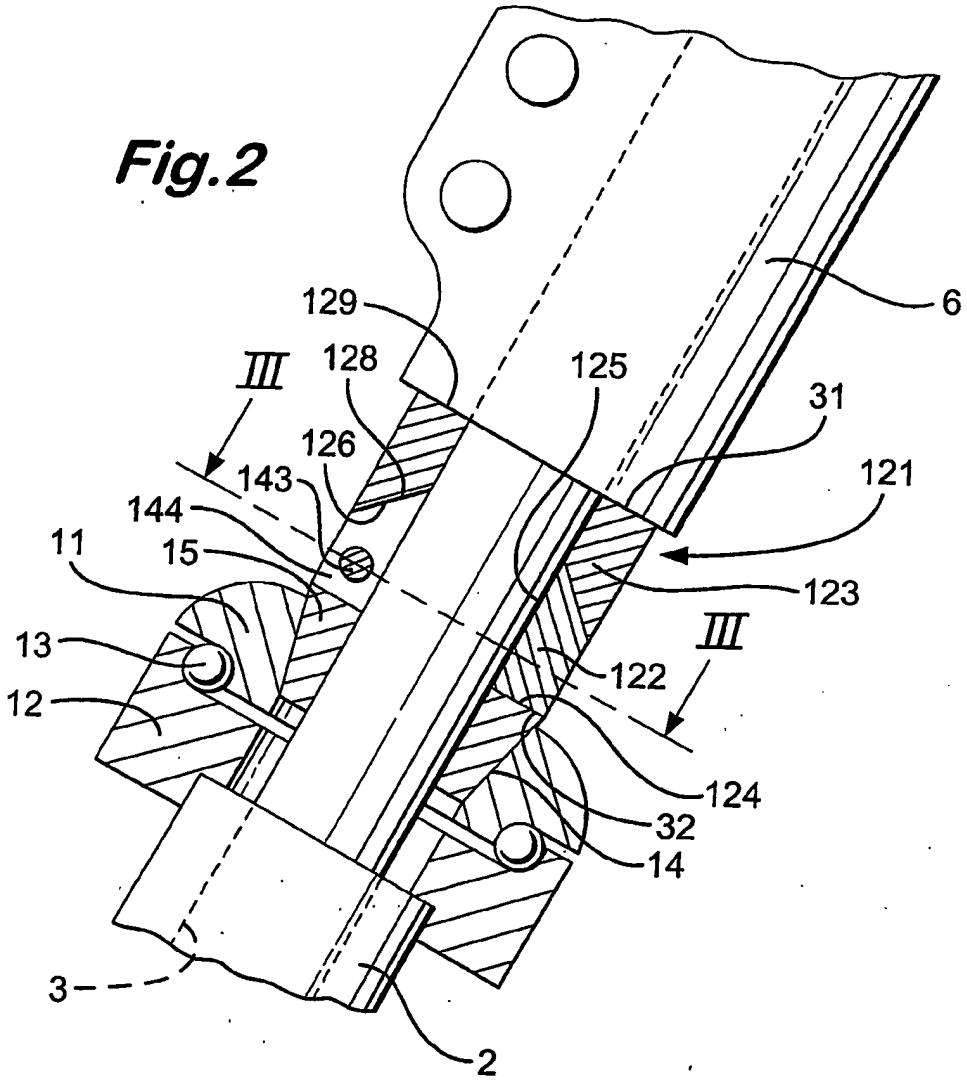

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Fig.3

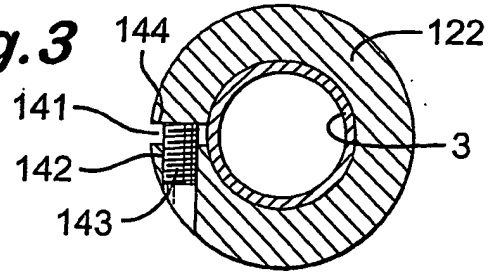
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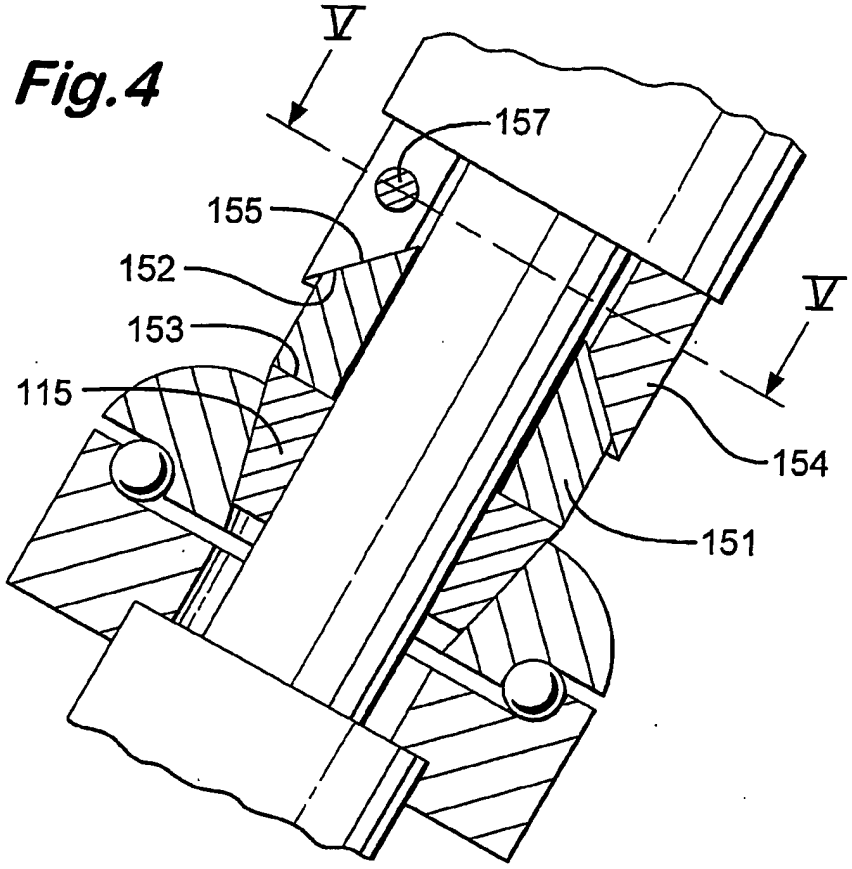
Fig.4



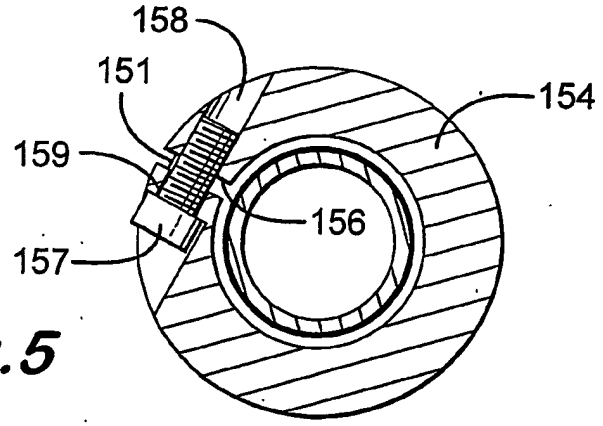


Fig.5

Fig.6

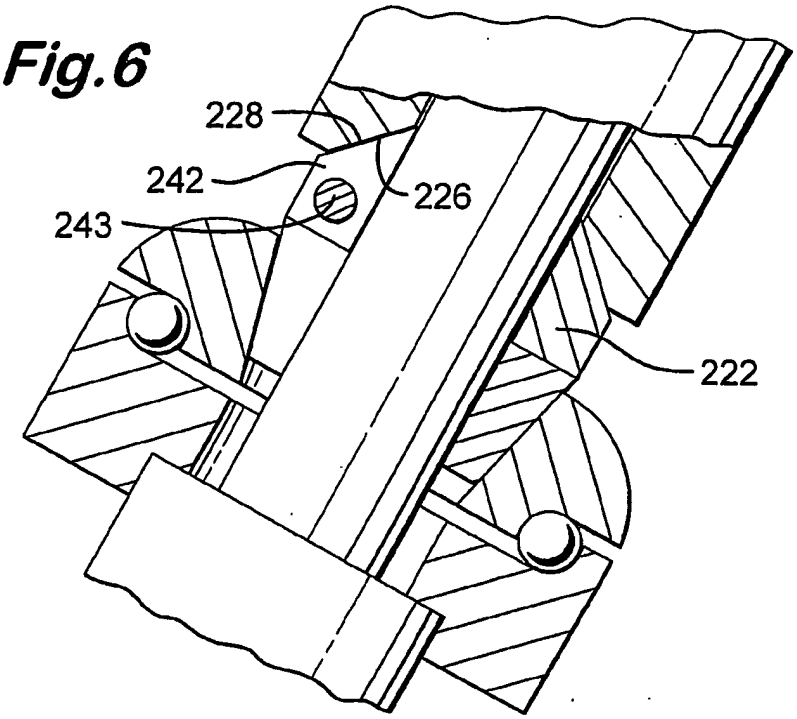
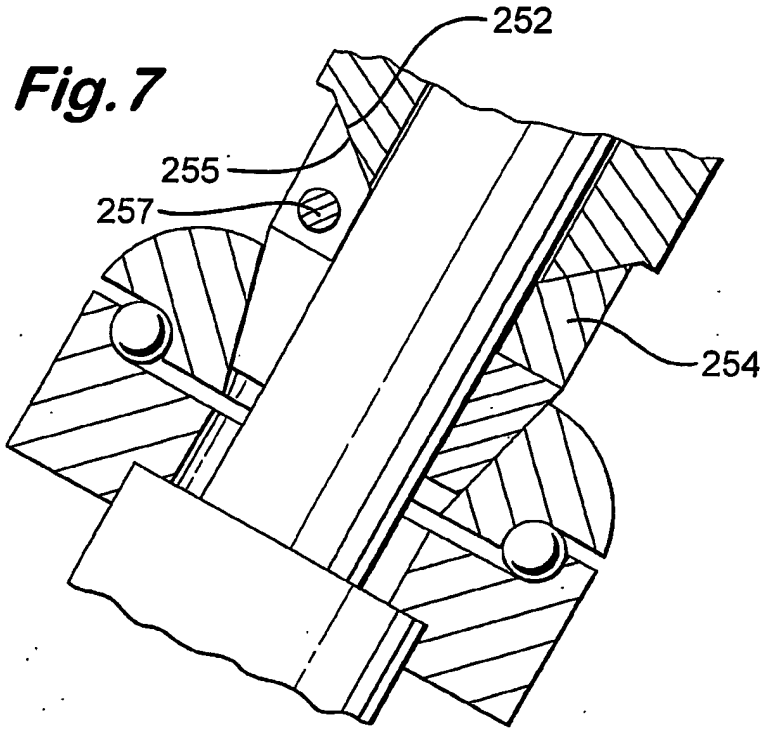


Fig.7



INTERNATIONAL SEARCH REPORT

Intern al Application No
PCT/GB 03/04324

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B62K21/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B62K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 540 457 A (JOHNSON) 30 July 1996 (1996-07-30) the whole document	1
A	US 6 254 115 B1 (LIN) 3 July 2001 (2001-07-03) the whole document	1
A	US 5 303 611 A (CHI) 19 April 1994 (1994-04-19) the whole document	1

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☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
13 January 2004	20/01/2004

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern al Application No
PCT/GB 03/04324

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